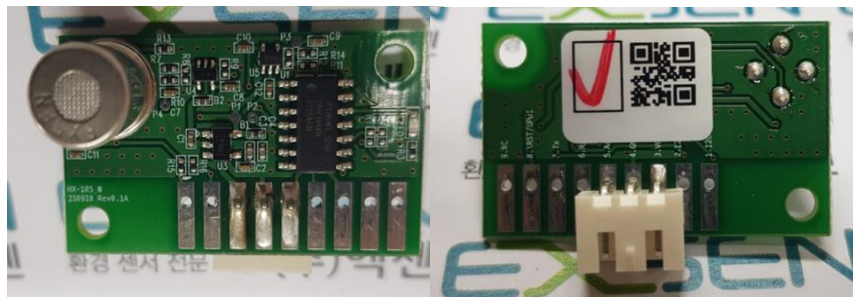


APPROVAL SHEET

MODEL NAME	CO2 SENSOR MODULE (HX-105N_A)
PART NUMBER	EX-AA-35215VN5KB
CUSTOMER NAME	-
CUSTOMER PART NUMBER	-
DATE	2022.01.28
REMARK	R00
SOFTWARE VERSION	V00
SOFTWARE CHECKSUM	0x-----



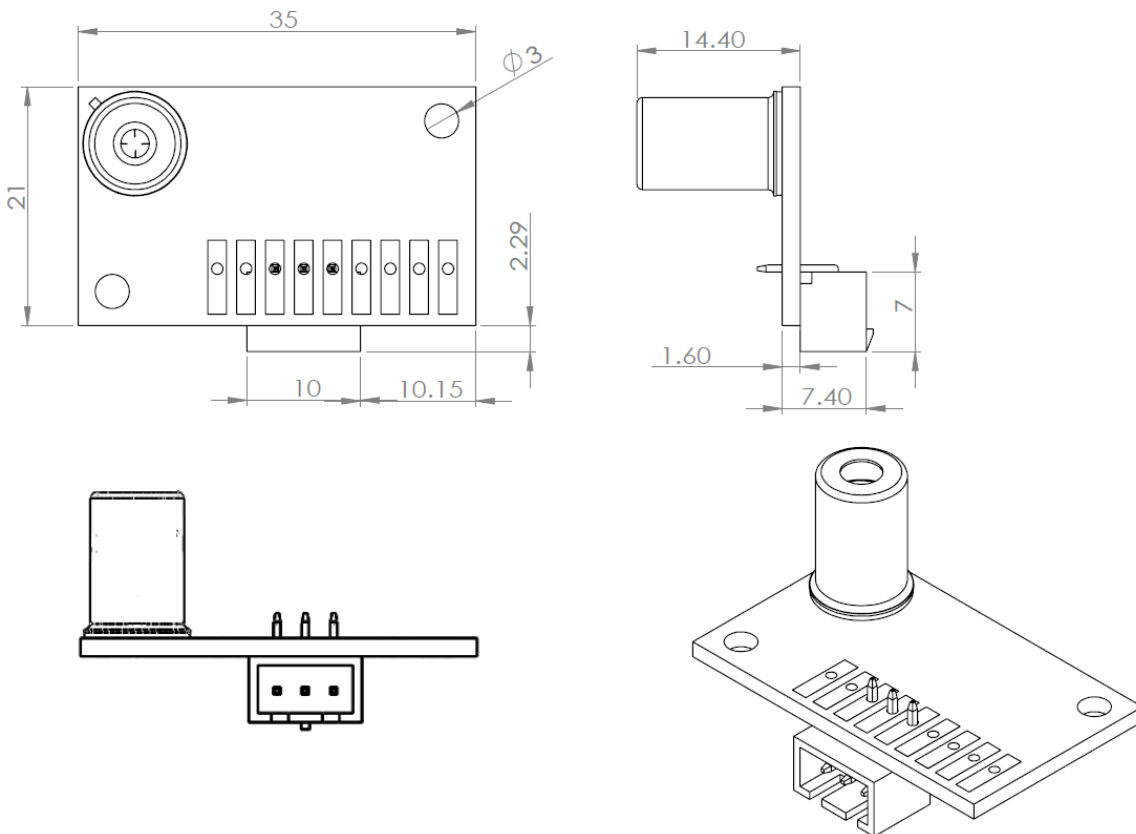
Contents

1. DATA SHEET

MODEL NAME	CO2 SENSOR MODULE (HX-105N_A)
PART NUMBER	EX-AA-35215VN5KB
DIMENSION	35 x 21 (mm ²), 14.4T
CO2 DETECTION RANGE	400~6,200 ppm
COMMUNICATION	Analog voltage output
APPLICATION	Carbon dioxide concentration display General Purpose

(1) Dimension

- **Small Sensor Module, 35 x 21 x 14.4 (L x W x H, mm)**



- **Connector: SMAW-250-03P, Pin No 3~5**

General Tolerance (mm)	
Linear	±0.3
Radius	±0.5

CO₂ Sensor Module

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(2) Sensor & electrical performance specification (T_a = 25°C)

Parameters		Condition	Symbol	Min	Typ	Max	Unit
Gas	Target gas	-	T _{Gas}	CO ₂			-
Data	Sensor type	-	EC	Electrochemical			
	Detection range	-	DD _R	400-6,200			ppm
	Resolution	-	D _R	1			ppm
	Accuracy ¹⁾	At Normal temp, humidity, pressure	D _A	-10	After starting 15 min	10	%
	D _{A3}		-25	3 min	25		
	D _{A10}		-15	10 min	15		
Time	Response	-	T _{Res}	2min for 90% for diffusion sampling method			
	Warm-up	-	T _{WU}	1	3	-	min
	Life-time	-	T _{LT}	10 years			-
Power	Input	-	V _{IN}	4.5	5	5.3	V
	Current Consumption	-	P _A	-	0.12	0.15	A
	Warm-up consumption	-	P _W	-	0.6	0.8	W
Output	Interface connections	-	O _C	Analog output			V
	AVO-ppm	-	AVO_ppm	400~6,200			ppm
	AVO-State	-	Stat	0.4V~4.4V: Normal			
	AVO-Error	-	Error	4.0V: Warm-up ²⁾ , 0.3V: Error ³⁾			
	Sampling interval	-	T _{SPL}		1		Hz
	Connector	-	CNT	SMAW-250-03P			YEONHO
Ambient	Operating Temp	-	O _T	0	25	50	°C
	Operating Humidity	No condensing	O _H	0	-	95	%
	Storage Temp	-	S _T	-40	25	60	°C
	Storage Humidity	Pack in moisture proof bag	S _H	5	-	90	%
Calibration		-	CAL	Not required and Self mode is ready			-
Warranty				1 year			

1) 정확도는 센서의 전원 연결 후 48 시간 이후에 측정 가능합니다.

2) Warm-up 신호는 전원 연결 후 3 분 동안 4.0V 로 출력됩니다.

2. Terminal descriptions

- Connector

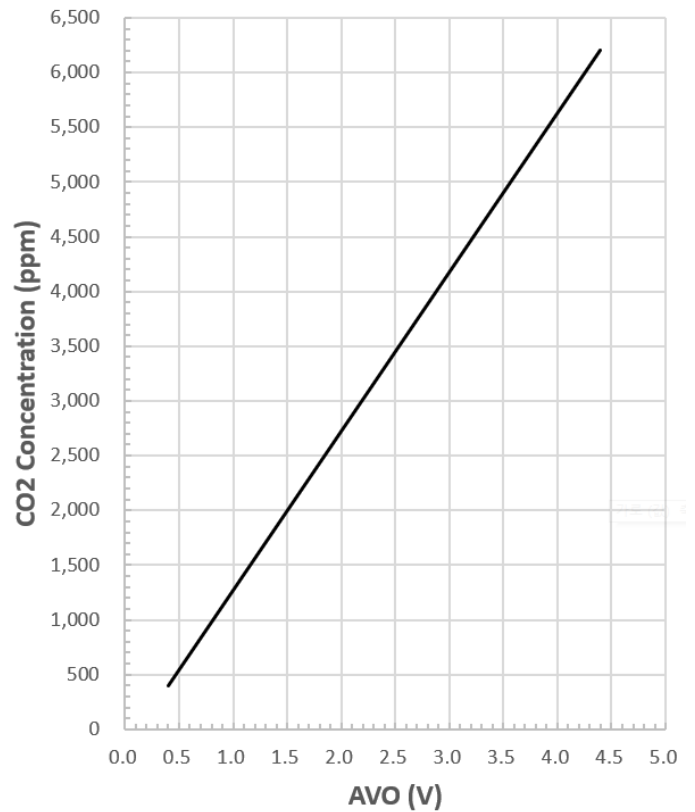
Model name	Maker	Type	Pin no	Pin to Pin
SMAW-250-03P	YEONHO	FEMALE	3	No 3 to No 5

Pin No.	Symbol	Description
1	SCL	Digital input, Serial clock for I2C communication
2	SDA	Digital bidirectional, Serial Address and Data
3	VCC	Supply, 5V
4	GND	Ground
5	DAC-out	Analog output (0.4~4.4V), Warm-up = 4.0V, Failure = 0.3V
6	Rx	UART Rx
7	Tx	UART Tx
8	Manufacturer	UPDI
9	Manufacturer	NC

3. Communication descriptions

Analog Voltage Output (AVO, V)

AVO (V)	CO ₂ Concentration	AVO (V)	CO ₂ Concentration
0.4	400	2.6	3,590
0.5	545	2.7	3,735
0.6	690	2.8	3,880
0.7	835	2.9	4,025
0.8	980	3	4,170
0.9	1,125	3.1	4,315
1	1,270	3.2	4,460
1.1	1,415	3.3	4,605
1.2	1,560	3.4	4,750
1.3	1,705	3.5	4,895
1.4	1,850	3.6	5,040
1.5	1,995	3.7	5,185
1.6	2,140	3.8	5,330
1.7	2,285	3.9	5,475
1.8	2,430	4	5,620
1.9	2,575	4.1	5,765
2	2,720	4.2	5,910
2.1	2,865	4.3	6,055
2.2	3,010	4.4	6,200



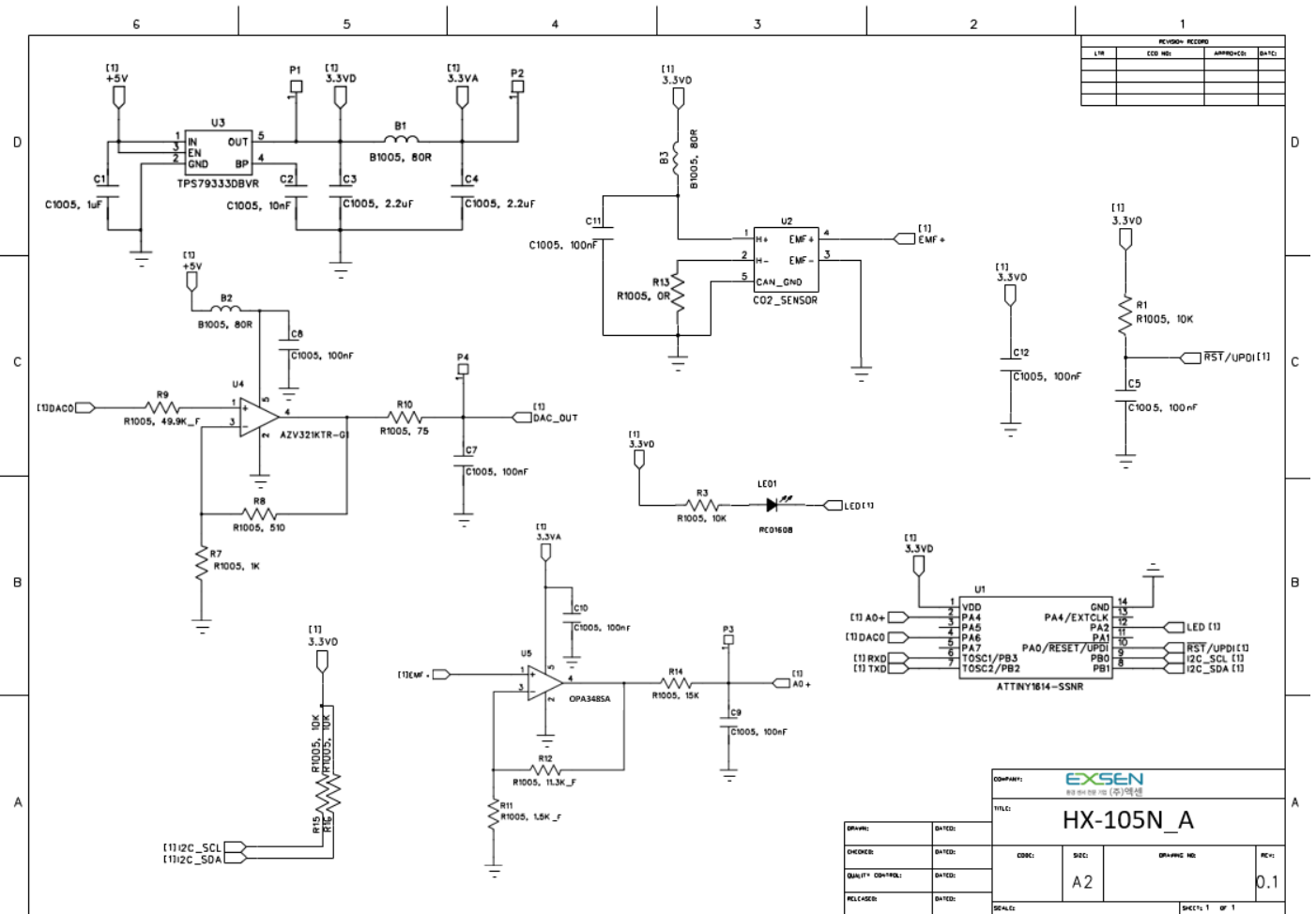
$$CO_2 \text{ Concentration (ppm)} = 1450 \times AVO(V) - 180$$

CO₂ Sensor Module

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4. Circuit

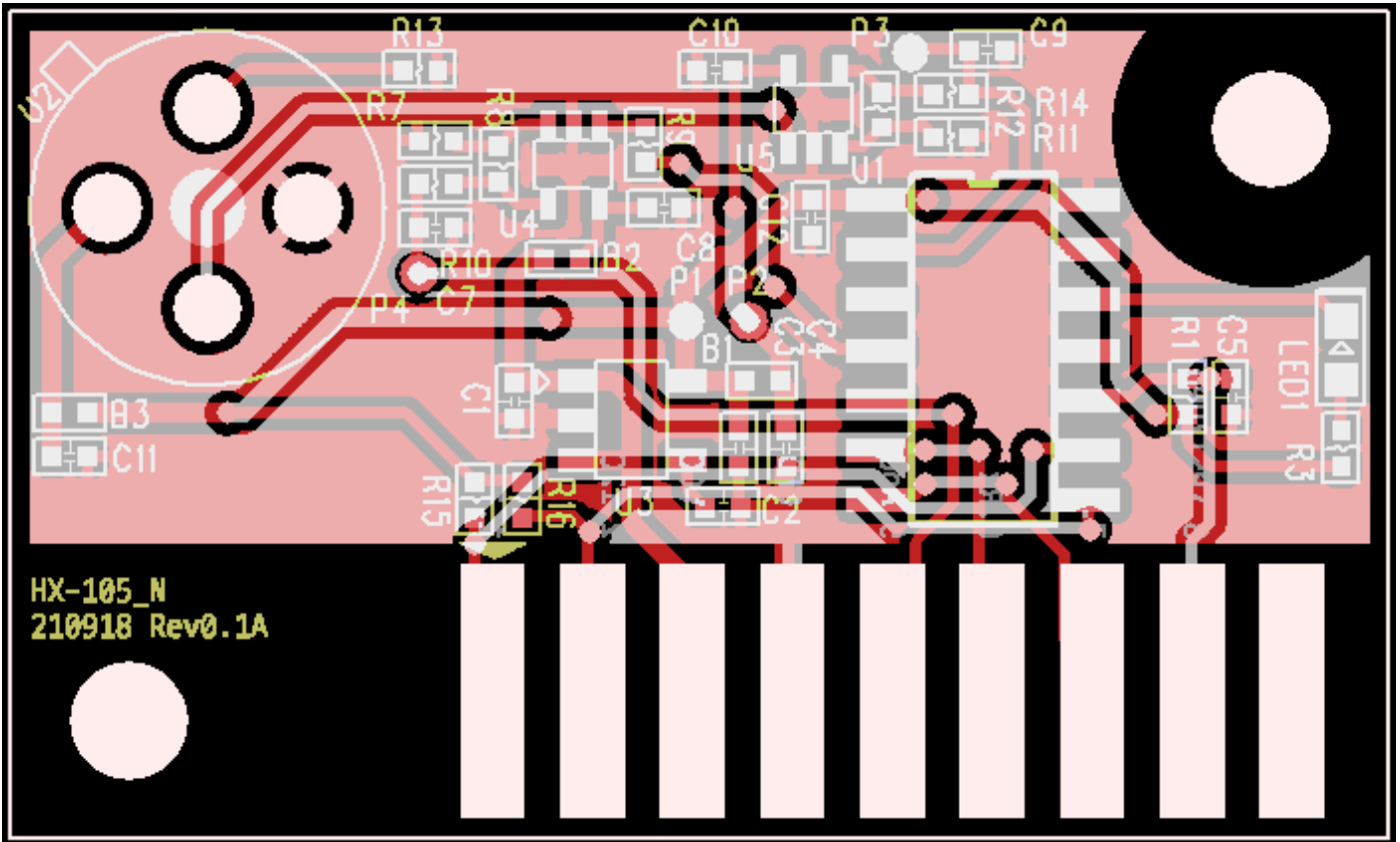
(1) Circuit



CO₂ Sensor Module

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(2) PCB



5. Partlist

No.	Location	Description	Specification	Unit	Q'ty
1	U1	ATTINY1614-SSNR	IC, MCU, 14 pin, Microchip	ea	1
2	U2	CO2_SENSOR	CO2_SENSOR	ea	1
3	U3	TPS79333DBVR	TPS79333DBVR	ea	1
4	U4	AZV321KTR-G1	AZV321KTR-G1	ea	1
5	U5	OPA349SA	OPA349SA	ea	1
6	LED1	LED1608	LED1608	ea	1
-	R1	Resistor	실장X	-	-
7	R3	Resistor	R1005, 10K	ea	1
8	R7	Resistor	R1005, 1K	ea	1
9	R8	Resistor	R1005, 510	ea	1
10	R9	Resistor	R1005, 49.9K_F	ea	1
11	R10	Resistor	R1005, 75	ea	1
12	R11	Resistor	R1005, 1.5K_F	ea	1
13	R12	Resistor	R1005, 11.3K_F	ea	1
14	R13	Resistor	R1005, 0R	ea	1
15	R14	Resistor	R1005, 15K	ea	1
16	R15	Resistor	R1005, 10K	ea	1
17	R16	Resistor	R1005, 10K	ea	1
18	B1	Bead	B1005, 80R	ea	1
19	B2	Bead	B1005, 80R	ea	1
20	B3	Bead	B1005, 80R	ea	1
21	C1	Chip capacitor	C1005, 1uF	ea	1
22	C2	Chip capacitor	C1005, 10nF	ea	1
23	C3	Chip capacitor	C1005, 2.2uF	ea	1
24	C4	Chip capacitor	C1005, 2.2uF	ea	1
-	C5	Chip capacitor	실장X	-	-
25	C7	Chip capacitor	C1005, 100nF	ea	1
26	C8	Chip capacitor	C1005, 100nF	ea	1
27	C9	Chip capacitor	C1005, 100nF	ea	1
28	C10	Chip capacitor	C1005, 100nF	ea	1
29	C11	Chip capacitor	C1005, 100nF	ea	1
30	C12	Chip capacitor	C1005, 100nF	ea	1

6. Firmware Version**(1) Revision**

1) V00: Initial firmware

7. Reliability Test Result

(1) Thermal Shock Test

- Ambient Condition: -40°C 30 min, 85°C 30 min, 150 cycle
- Electric Condition: No operation
- Sample No: 30 ea
- Pass condition: Operation, No Crack

Sample no.	Result	Sample no.	Result	Sample no.	Result
1	Pass	11	Pass	21	Pass
2	Pass	12	Pass	22	Pass
3	Pass	13	Pass	23	Pass
4	Pass	14	Pass	24	Pass
5	Pass	15	Pass	25	Pass
6	Pass	16	Pass	26	Pass
7	Pass	17	Pass	27	Pass
8	Pass	18	Pass	28	Pass
9	Pass	19	Pass	29	Pass
10	Pass	20	Pass	30	Pass

(2) Operating Endurance Test

- Ambient Condition: 25°C, 1000hr
- Electric Condition: 5V
- Sample No: 30 ea
- Pass Condition: CO₂ gas exposure test (ppm Tolerance: < ±10%,@1000 ppm
@985 ppm

Sample no.	Result		Sample no.	Result	
	ppm	%		ppm	%
1	1005	2.0%	16	1015	3.0%
2	952	-3.4%	17	1021	3.7%
3	1024	4.0%	18	980	-0.5%
4	1033	4.9%	19	1036	5.2%
5	965	-2.0%	20	987	0.2%
6	1027	4.3%	21	996	1.1%
7	997	1.2%	22	952	-3.3%
8	960	-2.5%	23	1046	6.2%
9	968	-1.7%	24	1004	1.9%
10	971	-1.4%	25	977	-0.8%
11	1035	5.1%	26	953	-3.2%
12	1028	4.4%	27	959	-2.6%
13	1009	2.4%	28	957	-2.8%
14	954	-3.1%	29	1036	5.2%
15	1036	5.2%	30	1015	3.0%

(3) High Temperature High Humidity Life Test

- Ambient Condition: 85°C, 85%, 500hr
- Electric Condition: Operation
- Sample No: 30 ea
- Pass condition: after test, apply 400 ppm CO₂ gas for 5 days.

then measure the CO₂ concentration under 1,000 ppm. (ppm Tolerance: <±10%)

@990 ppm

Sample no.	Result		Sample no.	Result	
	ppm	%		ppm	%
1	997	0.7%	16	980	-1.0%
2	995	0.5%	17	955	-3.5%
3	961	-2.9%	18	1043	5.4%
4	1021	3.1%	19	998	0.8%
5	1044	5.5%	20	1013	2.3%
6	973	-1.7%	21	1041	5.2%
7	966	-2.4%	22	953	-3.7%
8	1015	2.5%	23	1032	4.2%
9	1036	4.6%	24	988	-0.2%
10	1042	5.3%	25	976	-1.4%
11	1014	2.4%	26	966	-2.4%
12	1000	1.0%	27	1019	2.9%
13	998	0.8%	28	1043	5.4%
14	1025	3.5%	29	1043	5.4%
15	1017	2.7%	30	1038	4.8%

CO₂ Sensor Module

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(4) ESD(HBM)

- Ambient Condition: 25°C
- Electric Condition: No Operation, HBM: 2 kV, 3 times each pin
- Sample No: 30 ea
- Pass Condition: Operation, LED Blinking

Sample no.	Result	Sample no.	Result	Sample no.	Result
1	Pass	11	Pass	21	Pass
2	Pass	12	Pass	22	Pass
3	Pass	13	Pass	23	Pass
4	Pass	14	Pass	24	Pass
5	Pass	15	Pass	25	Pass
6	Pass	16	Pass	26	Pass
7	Pass	17	Pass	27	Pass
8	Pass	18	Pass	28	Pass
9	Pass	19	Pass	29	Pass
10	Pass	20	Pass	30	Pass

CO₂ Sensor Module

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(5) Gas Exposure Test

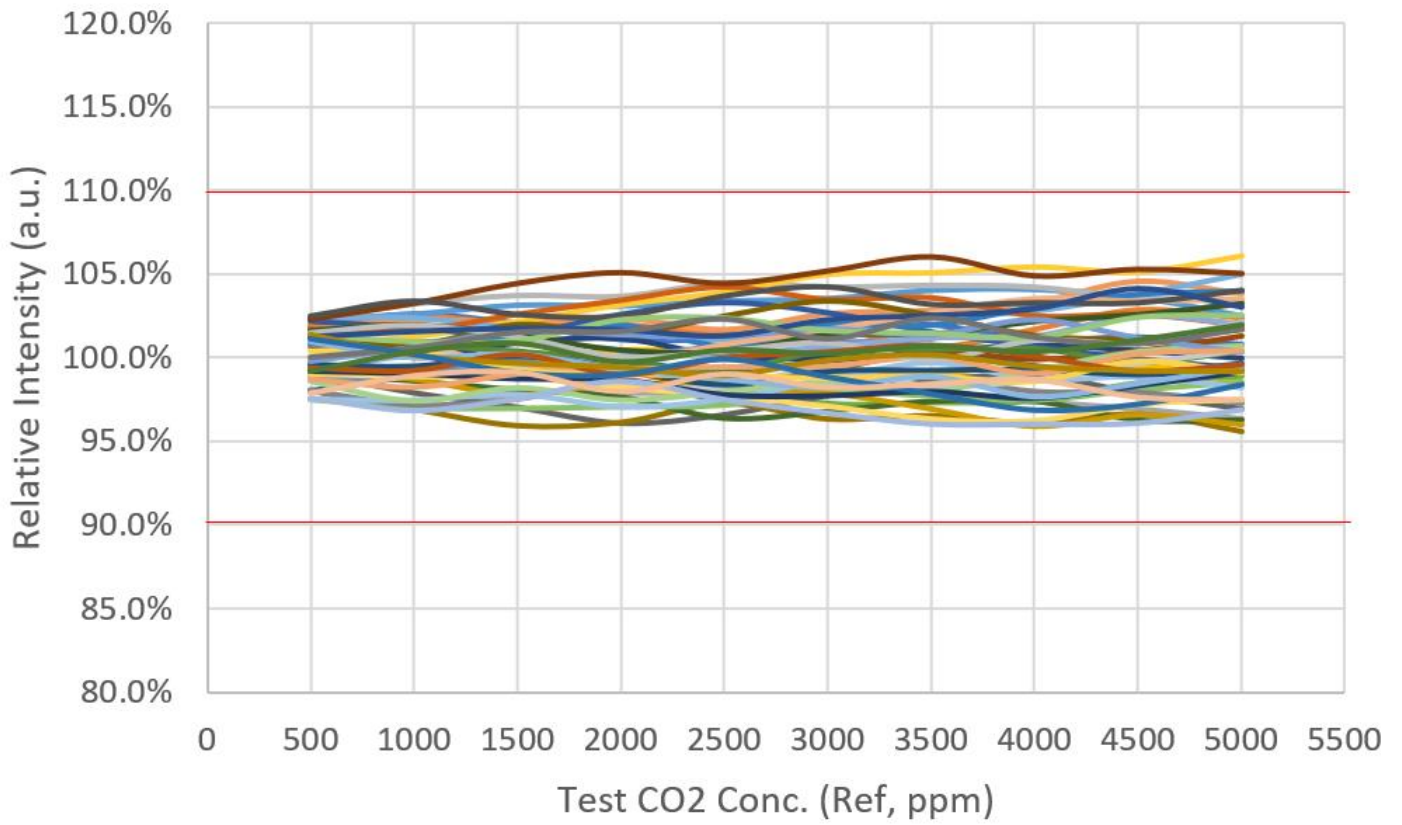
- Ambient Condition: 25°C
- Electric Condition: Operation
- Sample No: 50 ea
- Pass Condition: @500, 1000, 1500, 2000, 2500, 3000, 3500, 4000, 4500, 5000 ppm
ppm Tolerance: ±10% at each CO₂ concentration
- Test Result (Table, Relative Intensity compare with ref)

Sample No.	Result									
	500	1000	1500	2000	2500	3000	3500	4000	4500	5000
1	101.9%	102.7%	102.1%	101.1%	101.2%	102.0%	102.0%	101.1%	101.3%	100.8%
2	101.9%	102.5%	102.0%	102.0%	101.4%	101.8%	100.7%	101.7%	102.9%	102.4%
3	98.1%	96.9%	97.9%	97.9%	97.9%	98.1%	98.0%	97.4%	97.0%	96.4%
4	99.7%	100.9%	99.7%	100.5%	100.2%	99.2%	99.1%	98.7%	99.6%	98.6%
5	102.3%	102.6%	103.2%	103.1%	103.4%	103.6%	104.1%	104.1%	103.6%	102.5%
6	99.3%	99.2%	99.0%	99.2%	98.4%	97.3%	97.3%	97.4%	98.5%	98.9%
7	101.3%	100.1%	100.9%	101.2%	100.1%	100.0%	100.4%	100.8%	100.5%	100.0%
8	100.7%	100.9%	100.3%	99.2%	98.4%	99.3%	100.4%	99.9%	100.4%	101.3%
9	99.1%	97.9%	97.1%	96.1%	96.6%	97.8%	98.6%	99.0%	97.9%	97.0%
10	98.0%	96.9%	95.9%	96.1%	97.3%	96.3%	96.5%	96.1%	96.6%	95.6%
11	98.0%	98.9%	100.0%	99.8%	99.2%	99.8%	100.2%	99.5%	99.1%	99.7%
12	99.0%	98.6%	98.1%	97.7%	96.4%	96.8%	97.4%	97.4%	96.3%	96.3%
13	98.7%	99.0%	99.9%	100.1%	100.7%	100.9%	101.2%	102.3%	102.5%	103.3%
14	101.6%	102.3%	102.1%	102.4%	101.7%	102.6%	102.8%	103.3%	104.6%	103.8%
15	102.3%	103.2%	103.7%	103.7%	104.5%	104.2%	104.3%	104.2%	103.6%	103.4%
16	100.8%	101.3%	102.2%	103.2%	103.9%	105.0%	105.1%	105.4%	105.1%	106.1%
17	102.4%	102.4%	101.8%	101.5%	101.1%	101.3%	102.4%	102.8%	103.8%	105.0%
18	97.5%	97.0%	97.0%	97.1%	97.2%	98.0%	97.7%	97.5%	98.1%	98.6%
19	102.2%	101.8%	101.5%	102.6%	103.3%	102.7%	101.6%	100.7%	100.0%	99.4%
20	101.7%	101.6%	102.6%	103.5%	104.3%	103.5%	103.6%	102.5%	102.6%	102.0%
21	98.0%	97.2%	97.5%	98.6%	97.5%	98.7%	98.8%	98.0%	97.9%	97.3%
22	99.4%	98.8%	97.8%	98.5%	98.3%	97.9%	97.0%	95.9%	96.6%	96.0%
23	100.8%	100.9%	101.3%	102.0%	100.7%	102.0%	102.0%	103.1%	103.8%	104.0%
24	101.2%	100.8%	100.4%	99.8%	99.3%	100.5%	100.5%	100.6%	99.8%	100.4%
25	99.1%	100.1%	99.3%	100.1%	100.2%	100.7%	101.2%	101.3%	102.6%	102.0%
26	99.9%	100.7%	99.4%	99.7%	100.8%	101.7%	102.7%	103.5%	103.4%	103.5%
27	101.2%	100.6%	99.4%	98.4%	98.3%	99.4%	98.3%	98.7%	99.7%	100.5%
28	99.0%	98.9%	98.8%	98.2%	97.7%	97.1%	96.4%	96.3%	97.2%	97.5%
29	97.5%	97.5%	97.8%	97.1%	97.5%	98.7%	99.7%	98.7%	98.9%	98.2%
30	98.6%	97.4%	98.2%	97.5%	98.0%	98.6%	98.0%	99.3%	100.4%	100.8%
31	99.2%	99.1%	98.8%	98.7%	97.8%	97.8%	98.0%	97.6%	98.4%	99.2%
32	102.3%	103.3%	104.5%	105.1%	104.5%	105.2%	106.1%	104.9%	105.3%	105.1%
33	102.5%	103.4%	102.6%	102.5%	103.7%	104.3%	103.2%	103.3%	103.3%	104.1%
34	101.3%	100.8%	102.0%	101.5%	102.5%	103.4%	102.6%	101.4%	101.2%	101.7%
35	99.6%	99.5%	100.1%	99.4%	98.4%	99.2%	99.3%	99.3%	99.0%	99.4%
36	101.6%	102.0%	101.3%	100.5%	100.4%	101.4%	101.4%	102.2%	102.6%	103.2%
37	99.8%	100.7%	101.7%	101.4%	101.3%	101.8%	101.4%	102.3%	101.2%	100.4%
38	98.7%	98.2%	99.0%	99.3%	99.5%	99.5%	100.1%	99.1%	100.3%	100.5%
39	101.5%	102.0%	101.3%	100.1%	100.4%	100.9%	99.9%	101.1%	100.9%	102.2%
40	100.4%	100.4%	99.3%	99.0%	99.0%	98.8%	98.9%	98.6%	99.8%	99.1%
41	101.0%	100.1%	100.3%	99.4%	98.8%	98.3%	98.9%	97.7%	98.5%	99.5%
42	101.4%	101.0%	101.1%	102.3%	102.4%	101.7%	101.5%	101.3%	102.5%	102.6%
43	101.3%	101.6%	101.8%	101.7%	101.4%	102.3%	102.6%	103.0%	104.2%	103.1%
44	99.4%	99.3%	100.2%	99.0%	100.0%	100.4%	100.8%	100.1%	99.2%	99.6%
45	100.0%	100.6%	101.5%	101.6%	102.3%	101.1%	102.4%	101.2%	100.8%	101.7%
46	101.4%	100.2%	99.7%	99.4%	98.9%	99.9%	100.2%	99.5%	99.2%	99.2%
47	101.1%	100.2%	99.1%	99.0%	99.9%	98.9%	97.9%	96.9%	97.3%	98.4%
48	99.2%	100.4%	100.9%	99.8%	100.5%	100.3%	100.7%	100.4%	101.1%	102.0%
49	97.6%	96.9%	97.6%	98.6%	97.5%	96.7%	96.1%	96.1%	96.1%	96.9%
50	97.9%	99.0%	99.2%	98.0%	99.1%	98.3%	98.5%	98.7%	97.7%	97.5%

CO₂ Sensor Module

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- Test Result (Graph)



(6) Overvoltage Test

- Ambient Condition: 25°C
- Electric Condition: No Operation, Input Voltage: 5V ± 15% for 1 min after measure
- Sample No: 5 ea
- Pass Condition: No reset, No damage, No malfunction
- Refer the attached SGS Test Result (SGS-R16-1319_EN00)

Sample No.	Low-Voltage (Rated Voltage - 15%) 4.25V	Over-Voltage (Rated Voltage +15%) 5.75V
	Reset, damaged, Malfunction	
1	PASS	PASS
2	PASS	PASS
3	PASS	PASS
4	PASS	PASS
5	PASS	PASS

8. Packing Specification

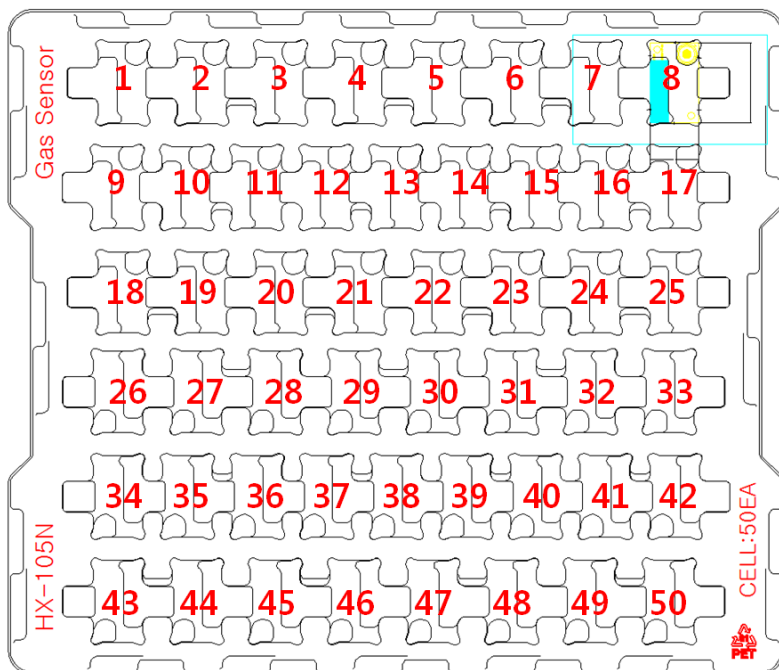
1. Sensor Cap Sealing tape: 1 sheet/sensor, Location: Top of Metal can

CAUTION!! Detach the sealing tape before using

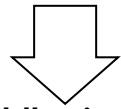
백색 시트: 센서 전원 인가 전 반드시 제거



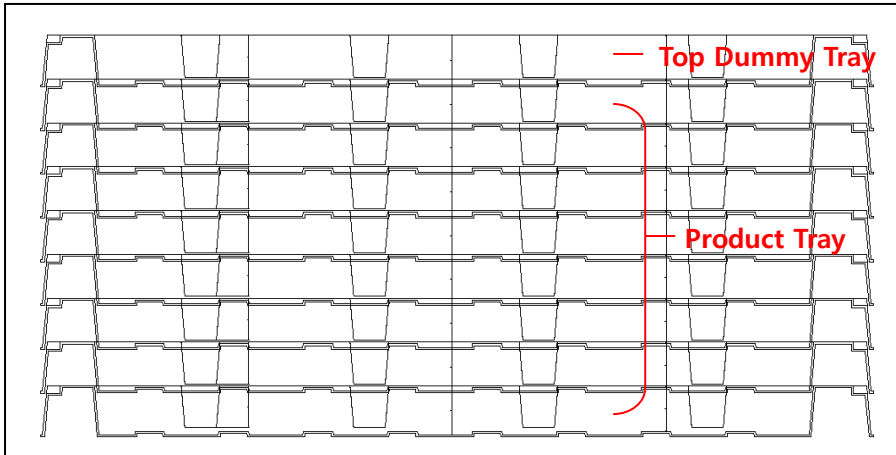
2. Poly bag
3. 8 Tray/bag
4. Q'ty: 50 ea(Max)/Tray



50 ea / Tray



Middle size box: 350 x 300 x 250 (mm)



Tray Stack: 9 (1 tray = dummy)

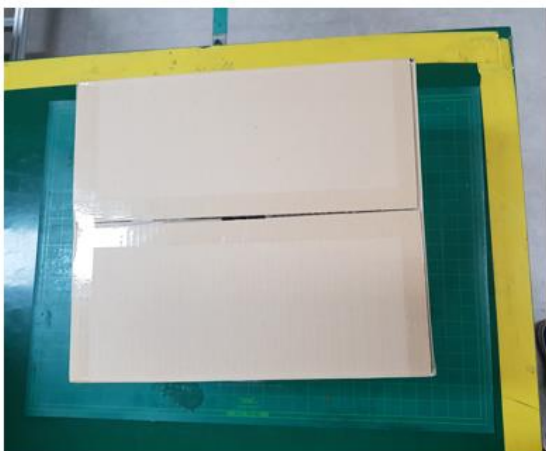
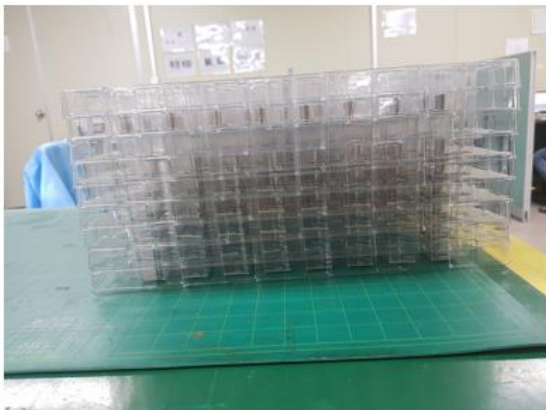
Product Tray: 8

Top Tray = Dummy

8 Tray x 50 ea

= 400 ea / Middle size box

Total Weight = 2.7 kg/box (full packing)



9. Cautions

(1) Moisture, Gas-Proof Package

- 1) When moisture or interfering gas is absorbed into the sensor module, it may cause malfunction. There is a possibility that may cause broad ppm tolerance of sensor. But normally sensor module can self-calibrated after 1 day. For this reason, the sensor module is used to keep moisture or interfering gas to minimum.

(2) Storage Conditions

- 1) Before/After opening the packing: The sensor module should be kept at 30°C or less and 60%RH or less. The sensor module should be used within a 3 months. When storing the sensor module the cap sealing tape is should be attached.
- 2) EXSEN sensor is sensitive to ambient condition while storing, if the sensor module exposed to air direct w/o cap sealing tape, the sensor module should be operated for 4 days after that the sensor self-calibrated at clean air.
- 3) Please avoid rapid transition in ambient temperature, humidity, interfering gas, especially in high humidity environments where condensation can occur.

(3) Handling

- 1) The sensor module is very sensitive to human touching. Don't touch the sensor pin w/o glove. It may occur the sensor malfunction.
- 2) The sensor module is temperature compensation device, so don't apply rapid transition in temperature by conduction, convection, radiation. rapid temperature transition can make sensor output ppm fluctuation.
- 3) The sensor could be damaged from high concentrated interfering gas. For example, ethanol Isopropyl alcohol or solvent to clean the PCB could be harm to sensor.
- 4) PCB coating solution or resin is harm to sensor. While curing to PCB coating, the resin outgas the interfering gas to sensor. It damages to sensor sensitivity. Occasionally, the damage works permanently. If the coating is required to use the sensor, seal the top of sensor firmly.

(4) Initializing of sensor (warm-up)

- 1) The sensor takes 3 minute to initialize their internal components. The sensor is basically heating device. so the initializing means warming up the device to sense the carbon dioxide.
- 2) The accuracy depends on the warming-up time. The sensor shows $\pm 25\%$ deviation at 3 min after starting and $\pm 15\%$ at 5min.

(5) Auto Calibration

- 1) The sensor is monitored their output by program of MCU. The MCU calibrate the baseline of sensor output by 1 day.
- 2) It is required to auto-calibrate, the sensor should be exposed to clean atmosphere at least 5 min/day. Because the sensor learns the baseline of clean air.

CO₂ Sensor Module

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- 3) The sensor shows reliable sensing data after 1 auto-calibration. Because storage condition of sensor could change the baseline of sensor at first. But this symptom is calibrated after 1 day by auto calibration.
- 4) After reliability test, the sensor should be exposed to clean air at least 3 days. The harmful environment change the sensor baseline. So give enough time to sensor to calibrate.

(6) Temperature changing

- 1) Rapid temperature changing makes signal fluctuation to sensor output. The fluctuation is stabilized soon when the temperature is stabilized.
- 2) The temperature changing is caused by convection, heat conduction, and thermal radiation.
- 3)

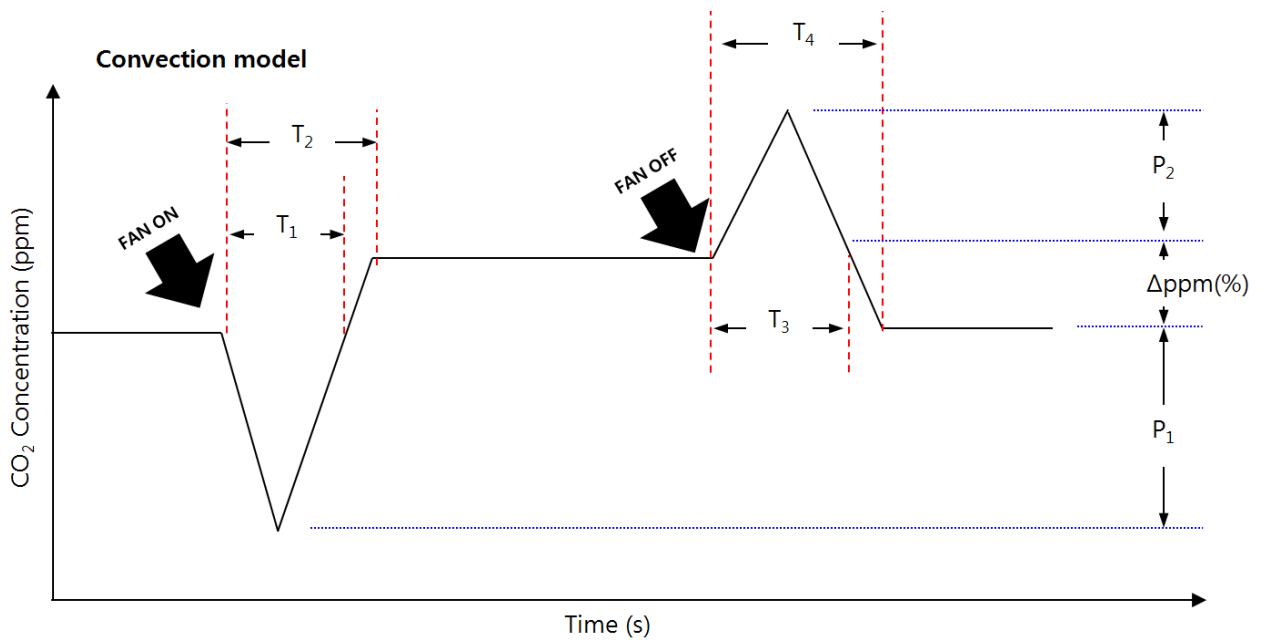


FIG. The convection model of temperature changing for sensor

HX-105N output data, @400 ppm, Ambient Temp = 25°C

FAN speed	T1 (s)	T2 (s)	T3 (s)	T4 (s)	Δppm (%)	P1 (%)	P2 (%)
High	200	400	200	300	10	12	10
Low	175	300	200	300	8	10	8

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